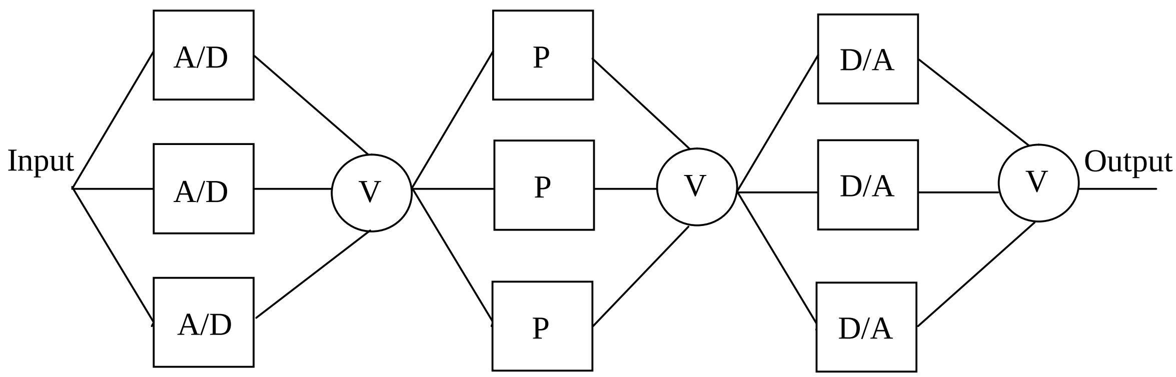
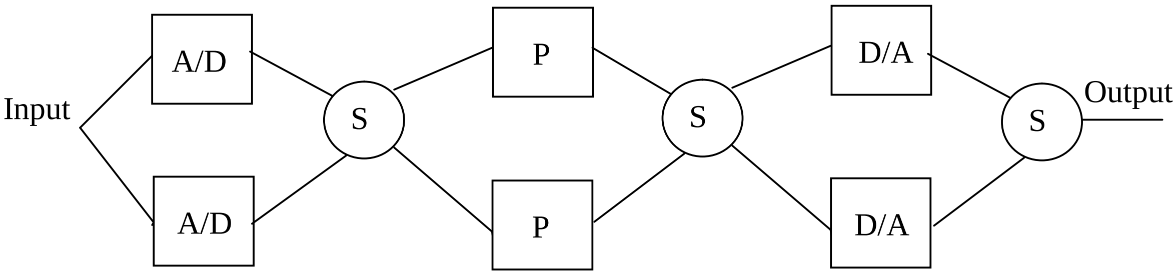
Solution 1:
Fault masking is any process that prevents faults is a system from introducing errors into the informational structure of that system. So its is basically used to hide the occurrence of faults and prevent faults from resulting in errors. Fault masking is an attractive technique for use in systems that can not allow even momentary erroneous results to be generated. Error correcting memories, for example, correct a memory's data before a system uses the data. Fault masking techniques tolerate the presence of faults and provide continuous system operation. In its basic form, a system would have just one voter, which would vote on the input form, say three inputs. Ultimately, no matter what the results of the inputs are, the system reliability is based upon the reliability of the voter. Consequently if the voter was to fail, then the whole system The most common limitation associated with a system that employs fault masking is to do with the voting system.

The first is deciding whether a hardware voter will be used, or whether the voting process will be implemented in software. A software voter takes advantage of the computational capabilities available in a processor to perform the voting process with a minimum amount of additional hardware. Also, the software voter provides the ability to modify the manner in which the voting is performed by simply modifying the software. The disadvantage of the software voter is that the voting can require more time to perform, simply because the processor cannot execute instructions and process data as rapidly as a dedicated hardware voter. The decision to use hardware or software voting will typically depend upon (1) the availability of a processor to perform the voting, (2) the speed at which voting must be performed, (3) the criticality of space, power, and weight limitations, (4) the number of different voters that must be provided, and (5) the flexibility required of the voter with respect to future changes in the system.

A second major problem with the practical application of voting is that the three results in a TMR system, for example, may not completely agree, even in a fault-free environment. The sensors that are used in many control systems can seldom be manufactured such that their values agree exactly.

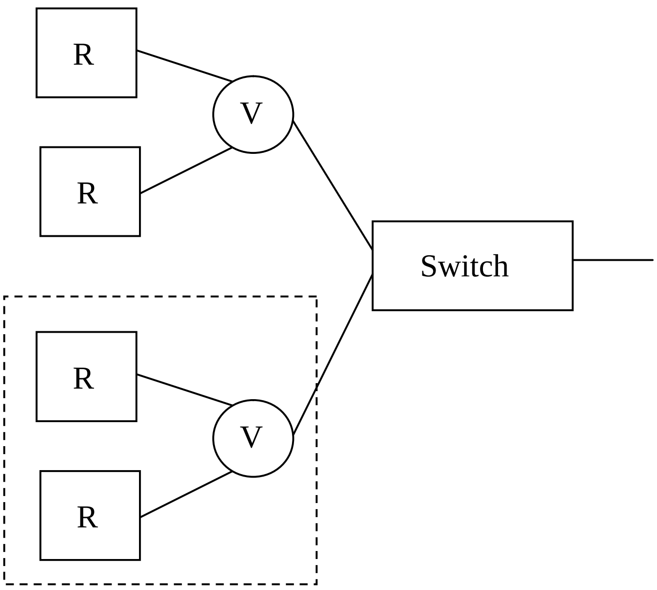
Solution 2:
One alternative to using both the A-D and the D-A conversion process is correct and does not contain any faults is to use a voting system (passive redundancy). This is shown below:





In this system (3MR based), the output from the A-D converters are voted upon, and the most popular result is then passed to the processor for processing. The output from the processor is then passed to five D-A converters. The output from these are then voted upon so as to ensure this conversion process is not erroneous.
As you can see in this case, the redundancy system is much more complex. However, it provides greater functionality and much more redundancy than the previous NMR system. In this case standby spares are used in conjunction with voters. The output from the A-D converters are passed through a restoring organ and then to the voter. Upon voting the result is passed to the processor and fed back into the restoring organ. If it is found that a particular unit is malfunctioning, then the restoring organ removes its input from the system and brings one of the standby machines online. Once processing of the data is complete an identical system is employed at the D-A conversion side.
As a result of this greater redundancy it would certainly choose the second system as a plausible means with which to implement the controller.

Solution 3:
For duplex system
The system is a duplex as shown in following



If we consider the ideal voter

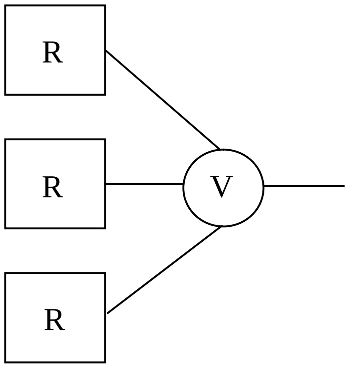
$$R_{sys} = R^2 + (1 - R^2) \cdot CR^2$$

For C=1

$$R_{sys} = R^2 + (1 - R^2)R^2 = 2R^2 - R^4$$

$$MTTF = \frac{1}{2}\lambda$$

For TMR System



$$R_{TMR} = 3R^2 - 2R^3$$

$$MTTF = \frac{5}{6}\lambda$$

Comparing with TMR

$3R^2 - 2R^3 > 2R^2 - R^4$ reliability

Therefore the TMR has higher reliability

$$\frac{5}{6}\lambda > \frac{1}{2}\lambda$$

TMR has longer MTTF

Solution 4:

Standby sparing can bring a system back to full operational capability after the occurrence of a fault, but it requires that a momentary disruption in performance occur while the reconfiguration is performed. If the disruption in processing must be minimized, *hot standby sparing* can be used. In the hot standby sparing technique, the spares operate in synchrony with the online modules and are prepared to take over at any time. In contrast to hot standby sparing is *cold standby sparing* where the spares are unpowered until needed to replace a faulty module. The disadvantage of the cold sparing approach is the time required to apply power to a module and perform initialization, prior to bringing the module into active service. The advantage of cold standby sparing is that spares do not consume power until needed to replace a faulty module. A satellite application where power consumption is extremely critical is an example where cold standby sparing may be desirable, or required. A process control system that controls a chemical reaction is an example where the reconfiguration time needs to be minimized, and cold standby sparing is undesirable, or unusable.